



# THE BHAWANIPUR EDUCATION SOCIETY COLLEGE

A MINORITY RUN COLLEGE. AFFILIATED TO UNIVERSITY OF CALCUTTA

RECOGNISED UNDER SECTION 2(F) & 12 (B) OF THE UGC ACT, 19

## Mid Term Syllabus for B.Sc. Part I Honours Papers

### ECONOMICS HONOURS

#### **Paper IA: Microeconomic Principles**

##### **Unit 1: The Economic Way of Thinking**

Normative Economics and Positive Economics - Methodology 1.2 Wants, Scarcity, Competing Ends and Choice - Defining Economics 1.3 Basic Economic Questions, Microeconomics and Macroeconomics. 1.4 Principles of Microeconomics – principles of individual decision making and principles of economic interactions – Introduce trade Off, Opportunity Cost, Efficiency, Marginal Changes and Cost-Benefit, Trade, Market economy, Market failure, Externality and Market power. 1.5 Interdependence and the Gains from Trade – production possibilities frontier and increasing costs, absolute and comparative advantage, comparative advantage and gains from trade.

##### **Unit 2: Market and Adjustments**

The Evolution of Market Economies. Price System and the Invisible Hand. 2.2 The Decision-takers – households, firms and central authorities 2.3 The Concepts of Markets – individual market, separation of individual markets, interlinking of individual markets. Difference among markets – competitiveness, goods and factor markets, free and controlled markets. Market and non-market sectors, public and private sectors, economies – free market, command and mixed. 2.4 Different Goods: Public goods, Private goods, Common resources and Natural Monopolies 2.5 Market and competition; Demand and its determinants; Supply and its determinants; relation of Quantity Demand with Price (using arguments of income and substitution effects); relation of Quantity Supply with Price (using increasing costs argument); Laws of Demand and Supply; Demand and Supply as Planning Curves; movement along and shift of the curve; Demand, Supply and Other factors. 2.6 Equilibrium and Disequilibrium 2.7 Market Adjustment without Government (with illustrations)

##### **Unit 3: Market Sensitivity and Elasticity**

3.1 Importance of Elasticity in Choice-Decisions 3.2 Method of Calculation – Arc Elasticity. Point Elasticity – definition. 3.3 Demand and Supply Elasticities – types of elasticity and factors effecting elasticity. 3.4 Demand Elasticity and Revenue 3.5 Income and Cross Price elasticity 3.6 Long run and Short Run elasticities of Demand and Supply 3.7 Case Studies – OPEC and Oil Price, Illegal Drugs.

#### **Paper IB: Macroeconomic Principles**

##### **Unit 1: Nature and Scope of Macroeconomics**

Distinction between Macro economics and Microeconomics - Aggregation and Macroeconomics 1.2 Goals and Instruments of Macroeconomics 1.3 Supply and Demand in Macroeconomics Introduce Economic growth, GNP gap, booms, recessions, depressions, business cycles, fiscal policy, monetary policy, international economic policy, macro equilibrium, exchange rate, inflation and deflation, stagflation, supply shock and tight



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money. 1.4 Brief history and Schools of Macroeconomics – Keynesian, Classical, New Keynesian and New Classical.

### **Unit 2: Accounting Output and Income**

The Circular Flow Explication - Measuring Output – Gross National Product - Nominal GNP, Real GNP and GNP Deflator. 2.2 The Two Approaches to measure GNP - The Final Goods Approach and Income Approach. 2.3 Intermediate goods and value added approach 2.4 Flow Statistics and Stock Statistics –Investment – Consumption –Capital stock 2.4 GNP, Gross Domestic product, Net National product, National Income and Disposable Income. 2.5 GNP and Economic Well Being

### **Paper IIA: Statistics for Economics**

#### **Unit 1: Data Presentation**

Data - Classification and presentation, Population and Sample, Collection of Data - Variable and Attribute. Frequency distribution - Diagrammatic representation of frequency distribution.

#### **Unit 2: Central Tendency**

Arithmetic Mean, Median and Mode (for both grouped and ungrouped data), Comparison of Mean, Median and Mode, Geometric and Harmonic Mean, Composite Mean. 2.2 Application: Index Numbers: their concept as weighted averages, Problems in the Construction of Index Numbers, Chain Index, Cost of Living Index Number (different formulae) 2.3 Wholesale Price Index and Cost of Living Index in India, Uses of Index Numbers.

### **Paper IIB: Mathematics for Economics**

#### **Unit 1: Introduction to Functions and Graphs**

The concept of sets and their operations Cartesian product, vocabulary of functions, graphs, polynomials, increasing and decreasing functions Local, global maximum, linear and non-linear functions and their slopes Differentiability and continuity of a function

#### **Unit 2: Derivatives and its uses in single-variable calculus**

Use of first derivatives for graphing, second derivatives and curvature 2.2 Maxima and minima (local and global) 2.3 Concepts of average and marginal change, and elasticity

#### **Unit 6: Difference Equations:**

Linear first-order difference equation and their solution 6.2 Linear second-order difference equation and their solution

#### **Unit 7: Differential Equations:**

Linear first-order differential equation 7.2 Linear second order differential equation with real equal and unequal roots and complex roots



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### PHYSICS HONOURS

Transformation properties of vectors; Differentiation and integration of vectors; Line integral, volume integral and surface integral involving vector fields; Gradient, divergence and curl of a vector field; Gauss' divergence theorem, Stokes' theorem, Green's theorem - application to simple problems; Orthogonal curvilinear co-ordinate systems, unit vectors in such systems, illustration by plane, spherical and cylindrical co-ordinate systems only.

Velocity and acceleration of a particle in (i) plane polar coordinates - radial and cross-radial components

(ii) spherical polar and (iii) cylindrical polar co-ordinate system;

Solution of second order linear differential equations with constant coefficients and variable coefficients by Frobenius' method (singularity analysis not required); Solution of Legendre and Hermite equations about  $x=0$ ;

Legendre and Hermite polynomials – ortho normality properties

Fourier expansion – statement of Dirichlet's condition, analysis of simple waveforms with Fourier series. Introduction to Fourier transforms; the Dirac-delta function and its Fourier transform; other simple examples

Basic assumptions of kinetic theory, Ideal gas approximation, deduction of perfect gas laws. Maxwell's distribution law (both in terms of velocity and energy), root mean square and most probable speeds. Finite size of molecules : Collision probability, Distribution of free paths and mean free path from Maxwell's distribution. Degrees of freedom, equipartition of energy (detailed derivation not required).

Thermal conductivity, diffusivity. Fourier's equation for heat conduction – its solution for rectilinear and radial (spherical and cylindrical) flow of heat.

Nature of intermolecular interaction : isotherms of real gases. van der-Waals equation of state,

LHO. Free and forced vibrations. Damping. Resonance. Sharpness of resonance. Acoustic, optical, and electrical resonances: LCR circuit as an example of the resonance condition. A pair of linearly coupled harmonic oscillators --- eigenfrequencies and normal modes. (7)

#### 2. Waves

Plane progressive wave in 1-d and 3-d. Plane wave and spherical wave solutions. Dispersion: phase velocity and group velocity.

#### Unit 6: Development, Inequality and poverty

Meaning of inequality, inequality measures, Lorenz Curve, Range, Coefficient of variation, Gini-coefficient, Kuznet's Inverted U hypothesis. 6.2 Poverty, relative and absolute deprivation with respect to income, Poverty line, Poverty measures – Head count ratio, Poverty gap ratio, Income gap ratio, Human Poverty Index. 6.4



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Social dimensions of poverty – rural poverty, women and ethnic minorities and indigenous populations. 6.5  
Tackling Poverty – The World Bank Approach

### **Paper IVB: Indian Economy Since Independence**

#### **Unit 1: Indian Economy at the time of Independence**

Features of Indian Economy around 1947-1950 and characteristics of economic underdevelopment of India  
(with reference to colonial rule of India)

#### **Unit 2: Planning: Evolution of India's Development Goal and Strategy**

The background and Structure of Indian Planning. Structural Constraints and India's development strategy – Choice of industrialization strategies – public vs. private sector, capital goods versus consumer goods – Mahalanobis Plan Model (basic argument), import substitution vs. export promotion strategy. Agriculture-industry relationship – demand side and supply side linkages– agriculture-industry terms of trade - food crisis of the 1960s and imperatives for agricultural growth, genesis of green revolution – fourth plan (basic argument). Poverty Eradication, foreign aid and self-reliance – Fifth Five Year Plan Model (basic argument). Regional inequality in India – causes; policies for balanced regional development. Planning deficiencies and its abandonment– 7th five year plan and Indian economic crisis. New Economic Policy – liberalisation, market and state (introduction)

#### **Unit 3: Land and Agriculture**

Land and tenancy system- sharecropping- Different dimensions of Land Reform – Productivity Debate – Marketable Surplus. Green Revolution – features of green revolution – positive and negative impacts of green revolution. Performance of Indian agriculture.



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### Chemistry Honours

#### (Inorganic Chemistry)

##### CHT 11a

**Unit-I. Atomic Structure:** Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers. Introduction to the concept of atomic orbitals; shapes, radial and angular probability diagrams of s, p and d orbitals (qualitative idea). Many electron atoms and ions: Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation. Electronic energy level diagram and electronic configurations of hydrogen-like and polyelectronic atoms and ions. Term symbols of atoms and ions for atomic numbers < 30.

##### CHT 11b

#### **Unit-I. Chemical Bonding and structure**

Ionic bonding: Size effects, radius ratio rules and their limitations. Packing of ions in crystals, lattice energy, Born-landé equation and its applications, Born-Haber cycle and its applications. Solvation energy, polarizing power and polarizability, ionic potential, Fajan's rules. Defects in solids (elementary idea).

Covalent bonding: Lewis structures, formal charge. Valence Bond Theory, directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, VSEPR theory, Partial ionic Character of covalent bonds, bond moment, dipole moment and electronegativity differences. Concept of resonance, resonance energy, resonance structures

**Unit-II. Acid-Base reactions:** Acid-Base concept: Arrhenius concept, Bronsted-Lowry's concept, relative strength of acids, Pauling rules. Lux-Flood concept, Lewis concept. Superacids, HSAB principle.

#### (Organic Chemistry)

##### CHT 12a

#### **Unit II. Bonding and physical properties**

Valence bond theory: concept of hybridisation, resonance (including hyperconjugation), orbital pictures of bonding ( $sp^3$ ,  $sp^2$ ,  $sp$ : C-C, C-N & C-O system). Inductive effect, bond polarization and bond polarizability, steric effect, steric inhibition of resonance.

##### CHT 12b

#### **Unit I. General treatment of reaction mechanism**

Mechanistic classification: ionic, radical and pericyclic; heterolytic bond cleavage and heterogenic bond formation, homolytic bond cleavage and homogenic bond formation; representation of mechanistic steps using arrow formalism. Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions,



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carbon radicals, carbenes – structure using orbital picture, electrophilic/nucleophilic behaviour, stability, generation and fate (elementary idea)

Reaction thermodynamics: free energy and equilibrium, enthalpy and entropy factor, intermolecular & intramolecular reactions. Application of thermodynamic principles in tautomeric equilibria [keto-enol tautomerism, composition of the equilibrium in different systems (simple carbonyl, 1,3 and 1,2- dicarbonyl systems, phenols and related system), substituent and solvent effect].

### (Physical Chemistry)

#### CHT 13a

##### Unit I. Kinetic theory and the gaseous state

Concept of pressure and temperature. Nature of distribution of velocities in one, two and three dimensions. Maxwell's distribution of speeds. Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values.

##### Unit II. Thermodynamics – I

Importance and scope, definitions of system and surroundings; type of systems (isolated, closed and open). Extensive and intensive properties. Steady state and equilibrium state. Concept of thermal equilibrium and the zeroth-law of thermodynamics. Thermodynamic coordinates, state of a system, equation of state, state functions and path functions. Partial derivatives and cyclic rule. Concept of heat and work (IUPAC convention). Graphical explanation of work done during expansion and compression of an ideal gas. Reversible and irreversible processes and work done.

First law of thermodynamics, internal energy (U) as a state function. Enthalpy as a state function. Heat changes at constant volume and constant pressure; relation between  $C_p$  and  $C_v$  using ideal gas and van der Waals equations. Joule's experiment and its consequence. Explanation of term  $(\delta U/\delta V)_T$ . Isothermal and adiabatic processes.

#### CHT 13b

##### Unit II. Chemical kinetics

Introduction of reaction rate in terms of extent of reaction; rate constants, order and molecularity of reactions. Reactions of zero order, first order, second order and fractional order. Pseudo first order reactions (example using acid catalyzed hydrolysis of methyl acetate). Determination of order of a reaction by half-life and differential method. Rate-determining and steady-state approximation – explanation with suitable examples.

Opposing reactions, consecutive reactions and parallel reactions (with explanation of kinetic and thermodynamic control of products; all steps first order).

Temperature dependence of rate constant: Arrhenius equation, energy of activation.



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### COMPUTER SCIENCE HONOURS

#### Paper-I

#### Group A: Computer Fundamentals

**Introduction to Computer and Problem Solving:** Information and Data.

**Hardware:** CPU, Primary and Secondary Storage, I/O Devices.

**Software:** System and Application.

**Generation of Computers:** Super, Mainframe, Mini and Personal Computer.

**Introduction to Programming Languages:** Machine Language, assembly Language, High Level Language.

**Problem Solving:** Flow Charts, Decision Tables and Pseudo Codes.

**Number Systems and Codes:**

**Number representation:** Weighted Codes, Non-weighted Codes, Positional, Binary, Octal, Hexadecimal, Binary Coded Decimal (BCD), Conversion of bases. Complement Notions. Binary Arithmetic, *Binary Codes:* Gray, Alphanumeric, ASCII, EBCDIC; Parity Bits. Single Error-Detecting and Correcting Codes, Hamming Codes, *Fixed and Floating point Arithmetic:* Addition, Subtraction Multiplication and Division.

**Boolean Algebra:**

Fundamentals of Boolean Algebra, Switches and Inverters, Functionally Complete Gates (AND, OR, NOT), NAND, NOR. Switching Function and Boolean Function. De Morgan's theorem, Minterm and Maxterm, Truth table and minimization of switching Function Up to four Variables, Algebraic and K-map method of logic circuit Synthesis: Two level and Multi level.

#### Group B: Introduction to Basic Electronics

**Elementary Circuit Theory: Kirchoff's Laws with simple Applications.**

Statement and illustration of Thevenin's & Norton's Theorems (Without Proof) in resistive network only and its simple applications.

**Elementary Physics of Semi-conductors:**

Intrinsic and Extrinsic Semiconductors, P & N type, Diode & its applications: Types of Diodes, P-N Junction Diodes, Biasing of a Junction diode, Depletion region & its effect, zener diodes & its applications, Diode as a rectifier, LED.

**Operational Amplifier:** Principle of differential amplifiers, CMRR of differential amplifiers, properties of ideal Op-amp, transfer characteristics of op-amp, concept of virtual ground, offset parameters and its uses as an inverting, non-inverting amplifiers, adder/subtractor, differentiator, integrator and scale changer, Schmitt trigger.





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### Group C: Digital System Design

**Combinational Circuits:** Realization of AND and OR Gates using diodes and NOT Gate using transistors, Standard Gate Assemblies, IC chips packaging nomenclature, Half and Full Adder(3 bits), Multi-bit adders - Ripple carry and Carry Look Ahead Adder, Adder/subtractor, BCD-Adder, Data selectors/multiplexers expansions, reductions, function realization, universal function realization, multi-function realization, Decoders/De-multiplexers: function realization, De-multiplexer and function realization, Encoder, Priority Encoder.

### Group - D: Computer Organization - I

Basic Computer Organization - IAS Computer, Von Neumann Computer, System Bus, Instruction Cycle, Data Representation, CPU Organization, Arithmetic and Logic Unit, Control Unit, CPU Registers, Instruction Registers, Program Counter, Stack Pointer.

Instruction: Operation Code and Operand, Zero, One, Two and Three address instruction, Instruction types, Addressing modes

### PAPER-II:

### Group - A

### Section - I: System Software Fundamentals and Operating Systems

**System Software Fundamentals:** Different System Software: A brief introduction to Operating Systems, Assemblers, Loaders, Linkers, Interpreters, Compilers, various phases of compilation.

**Introduction to Operating Systems:** What is OS? Multiprogramming, Multitasking OS, Concepts of processes, Files, Shell, System Calls; Structures: Monolithic, Layered, Virtual, Client Server and Distributed Model.

**Concepts of Synchronization:** Semaphores, Critical Regions, Monitor Inter Process Communication Mechanism.

**Processor Management:** Scheduling and its types.

**Dead Lock:** Introduction, Prevention, Avoidance, Detection, Recovery. Case Study: UNIX/LINUX, WINDOWS.

### Section II: Data Structure-I

**Introduction:** Concepts of Data types, Elementary structures, Data types and their interpretation.

**Arrays:** Types, Memory Representation, Address Translation, Functions of single and multi-dimensional arrays with examples.

**Linked Structures:** Singly and doubly linked list (non-circular and circular), List manipulation with pointers: Searching, Insertion and deletion of elements.





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### MATHEMATICS HONOURS

#### IA: CLASSICAL ALGEBRA

**1. Complex Numbers:** De-Moivre's Theorem and its applications, Exponential, Sine, Cosine and Logarithm of a complex number. Definition of  $a^z$  ( $a \neq 0$ ). Inverse circular and Hyperbolic functions.

**2. Polynomials with Real Co-efficients:** Fundamental theorem of Classical Algebra (statement only). The  $n^{\text{th}}$  degree polynomial equation has exactly  $n$  roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statements of Descartes' rule of signs and of Sturm's Theorem and their applications. Multiple roots. Relation between roots and coefficients. Symmetric functions of roots. Transformation of equations.

**1. Set, Mapping and Algebraic Structure:** Basic properties of sets including De-Morgan's Laws. Cartesian product of sets, Binary relation, Equivalence relation, Relation between equivalence relation and partition. Congruence of integers, Congruence Classes. Mapping: Injection, surjection, bijection, identity and inverse mappings. Composition of mappings and its associativity. Binary operations: Commutative and Associative binary operations. Algebraic structure: Concept of algebraic structure, definition (only) of group, ring and field – Real numbers with usual operations as an example.

#### IB: MODERN ALGEBRA I

**2. Group Theory:** Semigroup, Group, Abelian Group. Examples of groups from number system, root of unity, matrices, symmetries of squares, triangles etc. Groups of congruence classes. Klein's 4 group. Properties deducible from definition of group including solvability of equations like  $ax = b$ ,  $ya = b$ . Any finite semigroup having both cancelation laws is a group. Integral power of elements and laws of indices in a group. Order of an element of a group, Order of a group. Subgroups: Necessary and sufficient condition for a subset of group to be a subgroup. Intersection and union of subgroups. Necessary and sufficient condition for union of two subgroups to a subgroup.

**1. Transformation of Rectangular axes:** Translation, Rotation and their combinations. Theory of Invariants.

#### IIA: ANALYTICAL GEOMETRY OF TWO DIMENSIONS

**2. Pair of Straight Lines:** Condition that the general equation of second degree in two variables may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by  $ax^2 + 2hxy + by^2 = 0$ . Angle bisector. Equation of two lines joining the origin to the points in which a line meets a conic.



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### IIB: ANALYTICAL GEOMETRY OF THREE DIMENSIONS I

**1. Rectangular Cartesian Co-ordinates in Space:** Halves and Octants. Concept of a geometric vector (directed line segment). Projection of a vector on a coordinate axis. Inclination of a vector with an axis. Co-ordinates of a vector. Direction cosines of a vector. Distance between two points. Division of a directed line segment in a given ratio. Vector (directed line segment) Equality of two free vectors. Addition of Vectors. Multiplication by a Scalar.

Position vector, Point of division, Conditions of collinearity of three points and co-planarity of four points.

Rectangular components of a vector in two and three dimensions.

### IIC: VECTOR ALGEBRA

Product of two or more vectors. Scalar and vector products, scalar triple products and Vector triple products. Product of four vectors.

Direct application of Vector Algebra in (i) Geometrical and Trigonometrical problems (ii) Work done by a force, Moment of a force about a point.

Vector equations of straight lines and planes. Volume of a tetrahedron. Shortest distance between two skew lines.

**1. Real Number System:** Field Axioms. Concept of ordered field. Bounded set, L.U.B. (supremum) and G.L.B. (infimum) of a set. Properties of L.U.B. and G.L.B. of sum of two sets and scalar multiple of a set. Least upper bound axiom or completeness axiom. Characterization of  $\mathbb{R}$  as a complete ordered field. Definition of an Archimedean ordered field. Archimedean property of  $\mathbb{R}$ .  $\mathbb{Q}$  is Archimedean ordered field but not ordered complete. Linear continuum.

### IIIA: ANALYSIS I

**2. Sets in  $\mathbb{R}$ :** (a) Intervals, (b) Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Every open set can be expressed as disjoint union of open intervals (statement only). (c) Limit point and isolated point of a set. Criteria for L.U.B. and G.L.B. of a bounded set to be limit point of the set. Bolzano-Weierstrass theorem on limit point. Derived set.

**1. Matrices of Real and Complex Numbers:** Algebra of matrices. Symmetric and skew-symmetric matrices. Hermitian and skew-Hermitian matrices. Orthogonal matrices.

### IVA: LINEAR ALGEBRA

**2. Determinants:** Definition, Basic properties of determinants, Minors and cofactors. Laplace's method. Vandermonde's determinant.



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Symmetric and skew-symmetric determinants. Adjoint of a square matrix. For a square matrix  $A$ ,  $A \cdot \text{adj}A = \text{adj}A \cdot A = (\det A)I_n$ . Invertible matrix, Non-singular matrix. A square matrix is invertible if and only if it is non-singular. Inverse of an orthogonal Matrix.

**3. Elementary Operations on Matrices.** Echelon matrix. Rank of a matrix. Determination of rank of a matrix (relevant results are to be state only). Normal forms. Elementary matrices. Statements and application of results on elementary matrices.

**4. Vector/Linear Space:** Definitions and examples, Subspace, Union and intersection of subspaces. Linear sum of two subspaces. Linear combination, independence and dependence.